IV. *Corrections applied to the Great Meridional Arc, extending from latitude* 8° 9′ 38″,39, *to latitude* 18° 3′ 23″,64, *to reduce it to the Parliamentary Standard. By Lieutenant Colonel* W. Lambton, *F. R. S. and Corresponding Member of the Royal Academy of Sciences at Paris.*

Read January 9, 1823.

I have recently received from Captain Kater a printed paper from the Philosophical Transactions for 1821, giving an account of his experiments in examining and comparing the different standard scales. I have read with great attention and satisfaction the whole of his results, and am glad to find that the Commissioners for considering the subject of weights and measures, have adopted Mr. Bird's scale of 1760, as by that means there is now a universal standard of comparison, which applies to the French metre, and to all the measures used on the Continent.

From Captain Kater's results it appears, that my standard scale requires a multiplier of —,000018 to make it agree with the above scale of Mr. Bird; and that Ramsden's bar, used in the Trigonometrical Survey of Great Britain, requires the multiplier +,00007. That is to say, with respect to a measurement on the meridian, the degree depending on my brass scale must be multiplied by, 000018 and the product subtracted from the measure given by the scale, to reduce it to what it would have been, had it been measured by what is now the parliamentary standard; and the degree depending on RAMSDEN'S bar, must be multiplied by ,00007, and the product added to the measure given by the bar, to reduce it to the standard measure.

Now the arc which I have measured depends on both these standards, as I had a new chain sent out by Mr. BERGE in 1802, which was laid off from RAMSDEN'S bar at the temperature of 52°; and this chain has never been used as a measuring chain, but as a standard chain with which to compare the other, till after the base near Gooty was measured, when the irregularity in the wear of the measuring chain was first discovered; for then the brass standard *scale* was had recourse to, and a correction applied to the base; and the triangles computed back to Yerracondah, one of the meridional stations about half way between the base near Bangalore and that near Gooty: and this is the correction alluded to in page 487 in the second part of the Philosophical Transactions for 1818. It thence follows, that the meridional distance from Yerracondah to Daumergidda depends on the brass standard *scale;* and that the meridional distance from Yerracondah to Punnae, near Cape Comorin, depends on the standard *chain*.

I shall now proceed to give the different sections of the arc, correcting them by the above factors as I go along.

	Feet.
From Namthabad back to Yerracondah, by the base, as measured in 1811. - - -	429120,6 *s*.
The same distance by the corrected base, is -	429134,3 *s*.
Hence, from Namthabad to Yerracondah, depending on the standard *scale*, is - -	429134,3 *s*.
From Yerracondah to Dodagoontah, depending on the standard *chain*, is - - -	332662,3 *s*.

	Feet.
From Dodagoontah to Putchapolliam, depending on the standard *chain*, is - - -	727334, *s.*
These three being corrected by their respective factors, we shall have the meridional distance from Namthabad to Yerracondah -	429126,6 *s.*
From Yerracondah to Dodagoontah - -	332685,6 *s.*
From Dodagoontah to Putchapolliam - -	727385,5 *s.*
From Namthabad to Putchapolliam - -	1489197,7 *s.*
or Fathoms	248199,6 *s.*

Now the celestial arc between Namthabad and Putchapolliam is $4^\circ 6' 11'',28 = 4^\circ,10313$.

Hence $\frac{248199.6 \text{ Fathoms.}}{4^\circ.10313} = 60490,31$ the degree due to $13^\circ 2' 55''$, the middle point.

	Fathoms.
Then from Putchapolliam to Punnae, depending on the standard *chain*, is - - -	171516,75 *s.*
Which, corrected by its multiplier, is - -	171528,76 *s.*

And the celestial arc, is $2^\circ 50' 10'',54 = 2^\circ,83626$

Hence $\frac{171528,76}{2^\circ,83626} = 60477,09$ fathoms, the degree due to $9^\circ 34' 44''$ the middle point.

Then from Namthabad to Daumergidda, depending on the standard *scale*, is - -	178904,7
Which, corrected by its multiplier, is - -	178901,48

The celestial arc is $2^\circ 57' 23'' = 2^\circ,95648$.

Hence $\frac{178901.48}{2^\circ.95648} = 60511,65$ fathoms, the degree due to $16^\circ 34' 42''$ the middle point. From which we have the degrees as follows:

	° ′ ″	Fathoms.	
The degree for latitude	9 34 44	= 60477,09	Indian.
for latitude	13 2 55	= 60490,31	
for latitude	16 34 42	= 60511,65	

		Fathoms.	
The degree for latitude	47° 30′ 46″ =	60779,00	French.
for latitude	52 2 20 =	60824,26	English.
for latitude	66 20 12 =	60955,00	Swedish.

Then computing from Eq. 3, page 498, in the Philosophical Transactions for 1818, 2d. Part, we shall have the ellipticity of the earth as follows:

				Mean
By the Indian and French	$\frac{1}{310,07}$;	$\frac{1}{309,64}$;	$\frac{1}{313,73}$;	$\frac{1}{311,15}$
By the Indian and English	$\frac{1}{310,3}$;	$\frac{1}{309,94}$;	$\frac{1}{313,72}$;	$\frac{1}{311,32}$
By the Indian and Swedish	$\frac{1}{307,88}$;	$\frac{1}{307,55}$;	$\frac{1}{309,92}$;	$\frac{1}{308,45}$
			General Mean	$\frac{1}{310,31}$

	Fathoms.
Now half the terrestrial arc between Putchapolliam and Punnae, is - - - -	85764,38
To which add half a degree south, or - -	30238,54
Their sum is the terrestrial arc between Putchapolliam and half a degree south of the middle point - - - - - - - -	116002,92
The latitude of half a degree south of the middle point, is 9° 4′ 44″, or more correctly 9° 4′ 43″,66, which is the latitude of the south extremity of an arc of complete degrees.	
Now the terrestrial arc between Putchapolliam and Namthabad, is - - - - -	248199,62
And between Namthabad and Daumergidda -	178901,48
The sum of these *three* arcs is the terrestrial arc between latitude 9° 4′ 44″ and Daumergidda	543104,02

The latitude of Daumergidda is 18° 3′ 23″,58
From which subtract - - - 9 4 43 ,66

Their difference or arc = - - - -	8° 58′ 39″,92	whose measure is -	543104,02
To which add - - - - - -	0 1 20 ,08	whose measure is -	1346,08
Gives the No. (n) of complete degrees =	9 0 0 ,00	whose measure (A) =	544450,10

Then, referring to page 509 Philosophical Transactions for 1818, Part II., we have $n = 9$; $A = 544450,1$; $a = (\sin^2.\overset{(2)}{l} - \sin^2.\overset{(1)}{l}) = ,006042 \cdot b = (\sin^2.\overset{(2)}{l} - \sin^2.\overset{(1)}{l}) + (\sin^2.\overset{(3)}{l} - \sin^2.\overset{(1)}{l}) + \&c. = ,263137$; $m' = \frac{310,31 \cdot A}{36 + 310,31 \cdot n} = 60477,76$; $A - n\,m' = 150,26$; $d = (A - m'n) \cdot \frac{a}{b} = 3,45$ and $Q = 571$ nearly.

From which the following Table has been computed; and it appears from *this table*, that the first degree in latitude 9° 34′ 44″ by the measurement is 0,67 fathoms in defect; and that the degree in latitude 16° 34′ 42″ (which may be taken for 16°34′44″) by the measurement is 3,21 fathoms in excess.

TABLE.

	Degrees in Fathoms.	Latitude. ° ′ ″
$\overset{(1)}{m} = \overset{(1)}{m} + 0$ - - - - - - - - -	60477,76	9 34 44
$\overset{(2)}{m} = \overset{(1)}{m} + d$ - - - - - - - - -	60481,21	10 34 44
$\overset{(3)}{m} = \overset{(1)}{m} + Q(\sin^2.\overset{(3)}{l} - \sin^2.\overset{(1)}{l})$ - - -	60484,95	11 34 44
$\overset{(4)}{m} = \overset{(1)}{m} + Q(\sin^2.\overset{(4)}{l} - \sin^2.\overset{(1)}{l})$ - - -	60489,03	12 34 44
$\overset{(5)}{m} = \overset{(1)}{m} + Q(\sin^2.\overset{(5)}{l} - \sin^2.\overset{(1)}{l})$ - - -	60493,42	13 34 44
$\overset{(6)}{m} = \overset{(1)}{m} + Q(\sin^2.\overset{(6)}{l} - \sin^2.\overset{(1)}{l})$ - - -	60498,13	14 34 44
$\overset{(7)}{m} = \overset{(1)}{m} + Q(\sin^2.\overset{(7)}{l} - \sin^2.\overset{(1)}{l})$ - - -	60503,13	15 34 44
$\overset{(8)}{m} = \overset{(1)}{m} + Q(\sin^2.\overset{(8)}{l} - \sin^2.\overset{(1)}{l})$ - - -	60508,44	16 34 44
$\overset{(9)}{m} = \overset{(1)}{m} + Q(\sin^2.\overset{(9)}{l} - \sin^2.\overset{(1)}{l})$ - - -	60514,03	17 34 44
Their sum	544450,10 = A	

With respect to the dimensions of the earth, and the length of the quadrantal arc of the elliptic meridian, let $^{(1)}l = 13°34'44''$; $m' = 60493{,}42$ fathoms, $e = \frac{1}{310{,}31} = {,}0032226$; then $3e = {,}0096678$; $3e \cdot \sin^2.^{(1)}l = {,}0005329$. Then if m be the degree on the meridian at the equator, where sin. l is o, $m = \frac{m'}{1 + 3e \cdot \sin^2.^{(1)}l} = \frac{60493{,}42}{1{,}0005329} = 60461{,}2$ fathoms, and therefore $60461{,}2 \cdot \frac{1+3e}{1+e} = 60850{,}17$ fathoms, the measure of the degree on the equatorial circle (see the different equations in the Philosophical Transactions for 1818, Part II.)

Put A = 57°, &c. the arc equal rad: then A $m = 3486457{,}9$ and therefore $2 \times 3486457{,}9 = 6972915{,}8$ fathoms for the diameter of the equatorial circle; equal the major axis of the elliptical meridian, which call a. Then if the minor axis be designated by b, we have $b = (1 - e)\,a = 6950442$ fathoms for the polar axis of the spheroid, supposing it to be an ellipsoid. But 3,14159, &c. $\times\ 6972916 = 21906074$ the circumference of the circumscribing circle. Then if $d = 1 - \frac{b^2}{a^2} = {,}0064355$; we have $1 : 1 - \left(\frac{d}{2^2} + \frac{3d^2}{2^2.4^2}\right) :: 21906074 : 21871024$, the length of the elliptic meridian. Hence $\frac{21871024}{4} = 5467756$ is the length of the quadrantal arc, which, reduced to inches, and multiplied by 10,000000 we get 39,3677 inches for the metre at the temperature of 62°, which falls short of the French metre by ,0032 inches, when reduced to the same temperature.

This conclusion is very satisfactory, and I hope that equal success will attend my operations to the northward. I have already measured another section, which extends to latitude

21° 6′, having just returned from finishing it; and when all the necessary calculations and corrections are made, I shall draw out an account of the whole, and forward it to the Royal Society at a future period. The celestial arc has been determined by seven stars, but there are many now out of my reach, which I observed in the beginning.

It may be satisfactory to the mathematicians in Europe to know, that I am now advancing through Hindoostan; and, from what I can learn from the different publick authorities, I do not apprehend any difficulty. They are all inviting in their letters, and all seem desirous that I should go through their respective districts. If my present arc be continued direct, it will pass through Bopaul, and near Seronje, where I shall have again to observe the stars and measure a base; and if Scindiah's country be in a quiet state, my meridian will pass near Gualior, his capital; and my sixth section will terminate near Agra, on the Jumna. I have made up my mind to execute all this if I live, and continue to have that flow of health and spirits which have hitherto attended me. The results of such an extensive measurement must be interesting to scientific men; and I shall exert my endeavours in doing justice to the work, and in giving a faithful account of the operations.